(12) UK Patent Application (19) GB (11) 2 137 975 A

(43) Application published 17 Oct 1984

(21) Application No 8408932

(22) Date of filing 6 Apr 1984

(30) Priority data

(31) 8309857 (32) 12 Apr 1983 (33) GB

(51) INT CL³
C01B 31/36

(52) Domestic classification
C1A E2K1 PB5
U1S 1380 C1A

(56) Documents cited
GB A 2081240 GB 1497871
GB 1556881

(58) Field of search
C1A

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(54) Joining of Silicon Carbide Bodies

(57) Carbon material is sandwiched between two surfaces of reaction-bonded silicon carbide bodies and molten silicon is caused to flow between the surfaces and react with the carbon material to convert it to silicon carbide and bond the surfaces together. The carbon material may for example be colloidal graphite or graphite paper and may be mixed with silicon and/or silicon carbide powders. The molten silicon may be supplied from a paste including silicon powder which is applied to the bodies being joined so that it can flow between the surfaces to be bonded. The silicon in the paste may be protected from oxidation by a layer of carbon and/or glass.

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SPECIFICATION

Joining Silicon Carbide Bodies

This invention relates to the joining of silicon carbide bodies.

Reaction-bonded silicon carbide bodies are produced by reaction sintering of a coherent mixture (or green body) of carbon and silicon carbide powders in the presence of molten silicon whereby the carbon in the mixture is converted to bonding silicon carbide and a substantially continuous silicon carbide matrix is formed in a substantially continuous free silicon phase. The present invention seeks to provide a bond between two such reaction-bonded silicon carbide bodies.

According to the invention carbon material is sandwiched between surfaces of two reaction-bonded silicon carbide bodies to be joined and molten silicon is caused to flow between the surfaces and react with the carbon material to convert it to silicon carbide and provide a bond between the surfaces.

During the reaction between the carbon material and the molten silicon swelling occurs and the carbon material may be so arranged (and the quantities and reactants selected) that any gap between the surfaces to be joined is filled by expansion of the carbon material on its conversion to silicon carbide and by the molten silicon. It is intended that the carbon material and the silicon carbide formed from it should provide capillary passages through which the molten silicon is drawn and the carbon material is selected accordingly, depending on the gap between the surfaces to be joined. This gap is sometimes only narrow by virtue of careful machining of the surfaces to be joined and with a gap of, say, 0.05 mm the surfaces may be coated with colloidal graphite. With slightly wider gaps graphite paper may be used as the carbon material and with still wider gaps carbon material may be mixed with silicon and/or silicon carbide powders to provide a filler for the joint.

The silicon needed to flow between the surfaces to be joined may be supplied from a local source by forming the silicon as powder into a paste with, say, an epoxy resin and disposing the paste on the bodies being joined where, on raising the temperature to melt the silicon, the molten silicon can flow between the surfaces to be joined and contact the carbon material sandwiched between these surfaces. Unless a vacuum or inert atmosphere is maintained about the parts being joined the silicon paste has to be protected from oxidation during heating to melt the silicon. Accordingly a layer of carbon and/or a suitable glass may be provided over the outer surface of the paste when it is disposed on the bodies to be joined.

The silicon may contain alloying elements as disclosed in British Patent Specification No. 1,315,319 which help to wet the surfaces to be joined.

As an example of one way of carrying the invention into effect a spigot joint may be made between two tubes of reaction-bonded silicon carbide by wrapping graphite paper around the male spigot, inserting a graphite paper washer between abutting faces of the two tubes, or both, and firing the joint in contact with silicon by induction heating to 1400°C at a high frequency of at least 400 Hertz.

CLAIMS

1. The bonding of surfaces of two reaction-bonded silicon carbide bodies by sandwiching carbon material between the surfaces to be joined and causing molten silicon to flow between the surfaces and react with the carbon material to convert it to silicon carbide.

2. The bonding of surfaces as claimed in Claim 1 wherein the carbon material is colloidal graphite.

3. The bonding of surfaces as claimed in Claim 1 wherein the carbon material is graphite paper.

4. The bonding of surfaces as claimed in Claim 1 wherein the carbon material is mixed with silicon and/or silicon carbide powders.

5. The bonding of surfaces as claimed in Claim 1 wherein the molten silicon is supplied from a paste including silicon powder disposed on the bodies being joined where on melting the silicon can flow between the surfaces to be bonded.

6. The bonding of surfaces as claimed in Claim 5 wherein the silicon is protected from oxidation by a layer of carbon over the outer surface of the paste when it is disposed on the bodies being joined.

7. The bonding of surfaces as claimed in Claim 5 wherein the silicon is protected from oxidation by a layer of glass over the outer surface of the paste when it is disposed on the bodies being joined.

8. The bonding of surfaces as claimed in any preceding claim wherein the molten silicon contains alloying elements.

Printed in the United Kingdom for Her Majesty's Stationery Office, Demand No. 8818935, 10/1984. Contractor's Code No. 6378.
Published by the Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.